

REMARKS

The Present Invention and Pending Claims

Claims 1-5, 7, and 18-26 are pending and are directed to a flexible metal-clad laminate (claims 1-5, 7, and 19-25) and a flexible printed wiring board comprising the flexible metal-clad laminate (claims 18 and 26).

The Amendments to the Claims

Claims 1 and 20 have been amended to correct typographical errors. Claims 9-16 have been cancelled as being directed to nonelected subject matter in response to the restriction requirement. Applicants reserve the right to pursue any cancelled subject matter in a continuation, continuation-in-part, divisional application, or other application. Cancellation of any subject matter should not be construed as abandonment of that subject matter. No new matter has been added by way of these amendments.

Summary of Office Action

The Office has made the restriction requirement final. The Office has rejected claims 1-5, 7, and 18 under 35 U.S.C. § 103(a) as allegedly obvious in view of Ohmura et al. (US 4,377,652) in combination with Akahoshi (US 4,970,107). Claims 1-5, 7, and 18-26 have been rejected under 35 U.S.C. § 103(a) as allegedly obvious over Watanabe et al. (US 3,936,575) in view of Frost (US 3,984,375) and Akahoshi. Reconsideration of these rejections is hereby requested.

Discussion of Obviousness Rejections

The Office has rejected the pending claims as allegedly obvious in view of several references. Applicants traverse these rejections for the following reasons.

a. Ohmura et al. and Akahoshi et al.

The Office contends that the flexible metal-clad laminate of the invention is obvious in view of the disclosures of the Ohmura and Akahoshi references. Specifically, the Office contends that Applicants have not compared the laminate of the Ohmura reference after it has been subjected to temperatures of 400° C (as described in the examples of the Ohmura reference) to demonstrate that the laminate does not meet the requirements of the laminate claimed by Applicants.

As discussed previously in the "Response to Office Action" dated June 27, 2003, the Ohmura reference does not disclose the flexible metal-clad laminate recited in the pending claims. As described in the Rule 132 Declaration of Tomoharu Kurita submitted herewith,

Applicants produced a flexible metal-clad laminate using a polyamide-imide resin described in the Ohmura and, as a result, verified that the use of the polyamide-imide described in the Ohmura reference does not result in a flexible metal-clad laminate with the claimed characteristics.

Specifically, Applicants prepared the polyamide-imide resin of Run No. 1 of the Ohmura reference (see columns 13-14, Table 1) as described in Experiment 1(a) of the accompanying the Rule 132 Declaration. Based on the measurement of reduced viscosity, Applicants verified that the target polyamide-imide resin solution was obtained (see Experiment 1(b) of the Rule 132 Declaration). Applicants then used the polyamide-imide resin solution to prepare a flexible metal-clad laminate according to the methods described in the present specification. Samples were subjected to a heat-treatment at 100°C for 3 hours, at 150°C for 2 hours, and at 200°C for 30 minutes (Sample A) or a heat-treatment at 100°C for 3 hours, at 150°C for 2 hours, at 200°C for 30 minutes, and at 400°C for 30 minutes (Sample B). These heat conditions were reproduced from the conditions described in the Ohmura reference (see Column 14, "Example 1 & Comparative Example 1").

As a result, Applicants determined that the flexible metal-clad laminate produced from Sample A did not undergo crosslinking of the polyamide-imide resins. Additionally, the N-methyl-2-pyrrolidone insoluble content of the laminate produced from Sample A was not at least 1% (the experimental result was 0%) and the radius of curvature was not at least 15 cm (the experimental result was 1.8 cm) as recited in the pending claims. The laminate produced from Sample B did undergo crosslinking and had an N-methyl-2-pyrrolidone insoluble content of the laminate of 100%; however, the radius of curvature was not at least 15 cm (the experimental result was 3.2 cm) as recited in the pending claims.

Therefore, a flexible metal-clad laminate which satisfies the radius of curvature recited in the pending claims was not obtained when the polyamide-imide resin described in the Ohmura reference was subjected to a heat treatment under the heating conditions described in the Ohmura reference. A flexible printed wiring substrate produced using the flexible metal-clad laminate with a radius of curvature of 1.8 cm or 3.2 cm shows excessive curling, and thus cannot be used in electrical appliances, etc.

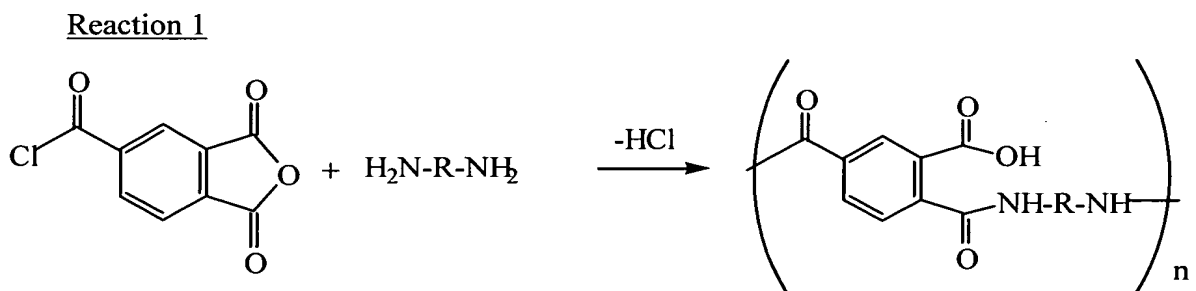
In that the Ohmura and Akahoshi references do not teach or disclose a laminate with a radius of curvature of at least 15 cm, or provide any motivation to modify the laminates to have such an enlarged radius of curvature, the pending claims cannot be considered to be obvious in view of either of the references alone or in combination. Accordingly, the obviousness rejection over the Ohmura and Akahoshi references is improper and should be withdrawn.

b. Watanabe et al in view of Frost and Akahoshi

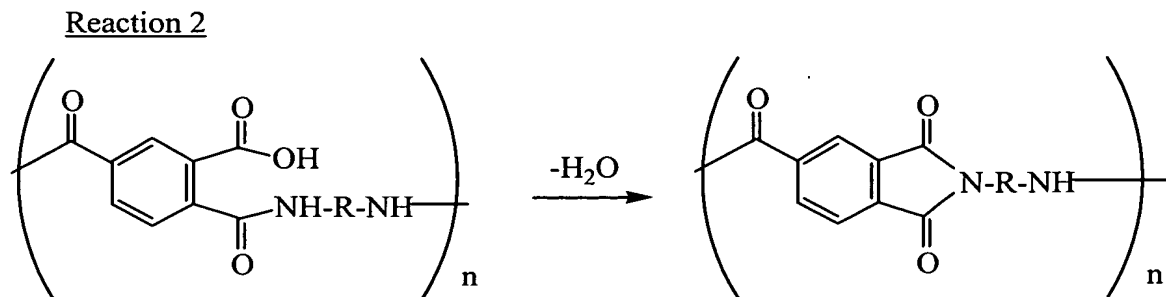
The Office contends that the flexible metal-clad laminate of the invention is obvious in view of the disclosures of the Watanabe, Frost, and Akahoshi references. Specifically, the Office contends that the Frost reference describes “curing” of a precursor of a polyamide-imide.

As stated in the previous “Response to Office Action” dated June 27, 2003, the Frost reference neither describes a polyamide-imide crosslinked structure nor discloses that the N-methyl-2-pyrrolidone-insoluble content of the flexible metal-clad laminate is at least 1% more due to the structure (see paragraph bridging pages 14 and 15 of the “Response to Office Action” dated June 27, 2003). “Curing” of a precursor of a polyamide-imide, as described in the Frost reference, is completely different from “crosslinking” of a polyamide-imide in the context of the present invention.

More specifically, the “curing” of the Frost reference denotes “curing of the intermediate” as described in column 4, line 34, of the Frost reference. The Frost reference adopts an “acid chloride process” for synthesizing a polyamide-imide resin (see Examples of the Frost reference). In this acid chloride process, trimellitic chloride is reacted with diamine compounds to yield a polyamide-acid serving as the precursor (intermediate) of the polyamide-imide (see Reaction formula 1 below).



The polyamide-acid (polyamide-imide precursor) that is the product of Reaction 1 (i.e., the “intermediate” described in column 4, line 34, of the Frost reference) is described in column 3, lines 35-45, of the Frost reference. According to the acid chloride process, the intermediate is subjected to intramolecular cyclization to yield a polyamide-imide resin (see Reaction 2 below).



Reaction 2 (intramolecular cyclization) is described at column 3, line 28, through column 4, line 37, of the Frost reference. The intramolecular cyclization of the amide acid is carried out at a temperature within a range of 25-175° C (see column 4, line 35, of the Frost reference), which is designated as “curing” of the polyamide-imide resin precursor. The “curing” described by the Frost reference is completely different from the intermolecular “crosslinking” of the present invention.

As discussed above, Frost neither describes nor suggests the crosslinking structure of the polyamide-imides, or that the N-methyl-2-pyrrolidone-insoluble content of the flexible metal-clad laminate is at least 1% due to this crosslinking structure. Moreover, the Akahoshi and Watanabe references do not teach or disclose a laminate with an N-methyl-2-pyrrolidone insoluble content of at least 1%, or provide any motivation to modify the laminates to arrive at that of the present invention. As such, none of the cited references, alone or in combination, can be considered to render obvious the present invention as defined by the pending claims. Accordingly, the obviousness rejection over the Watanabe, Frost, and Akahoshi references is improper and should be withdrawn.

Discussion of the Additional Comments in the Office's Response to Arguments

In addition to the Office's obviousness rejections, the Office contends that the data described in the Examples section of the specification does not agree with the scope of the claims. Applicants experimentally confirmed, however, that the properties of the laminates in the Examples were all within the scope of the pending claims, whereas the results of the laminates in the Comparative Examples were all outside the scope of the pending claims, as expected.

Applicants also verified by additional experiments whether or not the value of dimensional change at 200°C of the flexible metal-clad laminates obtained in Examples 9-12 met the requirements recited in the pending claims (i.e., a thermal gradient dimensional change of not more than 0.1% when heated at 200°C for 30 minutes). As described in Experiment 2 of the accompanying Rule 132 Declaration and summarized in Table II of the

Rule 132 Declaration, the dimensional changes of the laminates of Examples 9-12 were not more than 0.1%, as recited in the pending claims. Therefore, Applicants believe that the data in the specification agrees in scope with the pending claims.

Additionally, the Office contends that Applicants have not shown that polymers of formulas (1) and (2) require drying temperatures above 200°C to reach an insoluble content of 1% or more. As also described in the Rule 132 Declaration, Applicants verified by additional experiments that, following heat treatment at 200°C, the polyamide-imide resins represented by the general formula (2) do not have an insoluble content of at least 1% as recited in the pending claims and, therefore, that a crosslinking structure is not formed (see Experiment 3 of the Rule 132 Declaration).

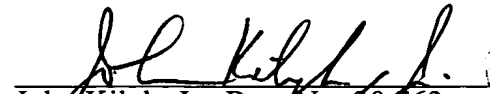
Moreover, the data of Table 2 of the specification demonstrates that the polyamide-imide resin represented by the general formula (1) does not have insoluble content of at least 1% unless the resin is subjected to heat treatment at greater than 200°C. Specifically, the data of Table 2 of the specification demonstrates that the polyamide-imide resins of formula (1) subjected to the heat treatment at a temperature above 200°C (for example, 200°C for 20 hours and 260°C for 3 hours) have an insoluble content of at least 1% (see Examples 1 to 7 and 12 of the specification). In contrast, a polyamide-imide resin of formula (1) subjected to a heat treatment at 200°C (200°C for 20 hours) has an insoluble content of less than 1% (see Comparative Example 1 of specification). Thus, Applicants have shown that multiple polymers of formulas (1) and (2) require drying temperatures above 200°C to achieve an insoluble content of at least 1% as recited in the pending claims.

Conclusion

The application is considered in good and proper form for allowance, and the Examiner is respectfully requested to pass this application to issue. If, in the opinion of the Examiner, a telephone conference would expedite the prosecution of the subject application, the Examiner is invited to call the undersigned attorney.

In re Appln. of Kurita et al.
Application No. 09/921,358

Respectfully submitted,



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